MOTOROLA

August 30, 2004

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Ex Parte Presentation, WT Docket No. 00-32

Dear Ms. Dortch:

Motorola, Inc. ("Motorola") hereby submits this *ex parte* presentation pursuant to Section 1.1206(b)(1) of the Commission's rules to provide further information regarding the pending issues involving technical rules for the 4.9 GHz band.

All parties to this proceeding appear to agree that the Commission should use a two tier approach under which a more relaxed mask is required at lower power levels and a tighter mask is required at higher power levels. In addition, all parties agree that the 802.11a mask is the appropriate one to use for lower power levels. However, in implementing the two tier approach two key issues remain for which the record shows agreement does not exist: 1) whether to use the DSRC-C mask or the original FCC mask for the higher power levels; and 2) the most appropriate power level at which to transition from the more relaxed to a tighter mask.

1. The DSRC-C Mask Should Be Used for Higher Power Operations

For higher power levels, Motorola recommends that the DSRC-C mask be used instead of the originally defined FCC mask. The initial breakpoint of the current FCC mask occurs at 40% of the authorized bandwidth from the assigned center frequency, this is much closer to the center frequency than the 802.11a mask proposed by both NPSTC and Motorola for lower power devices. If multi-carrier modulations such as OFDM are used, the initial breakpoint of the mask should have the same bandwidth on both masks, so that when the same sampling rate is used all the sub-carriers align and there is similar guard spacing to the edge of the mask, regardless of the power levels used. The DSRC standards developers understood this issue and accordingly ensured that the multiple masks specified for DSRC products at various power levels are all compatible with one another.

Mask Type	Inter-Subcarrier (BIN) Spacing
DSRC - A	20 MHz/ 64 = 312.5 kHz
DSRC - C	20 MHz/ 64 = 312.5 kHz
FCC	16 MHz/ 64 = 250 kHz

Table 1

Table 1 shows that Inter-Subcarrier (BIN) Spacing for a device with a 20 MHz authorized bandwidth, the spacing is the same for the two DSRC masks but would have to be reduced by

20% in the FCC mask to fit within the narrower 16 MHz bandwidth (80% of 20 MHz authorized bandwidth). The sub-carrier spacing needs to be the same for equipment using different masks to intercommunicate.

The 802.11a mask that both NPSTC and Motorola have recommended for lower power use at 4.9 GHz is identical to the DSRC-A mask. Therefore, for higher power operation, Motorola recommends replacing the current FCC mask with the DSRC-C mask. The DSRC-C mask should be used for higher power operation regardless of the power level breakpoint the FCC ultimately chooses for the shift from the 802.11a mask.

Section 3 of this letter discusses the specific FCC mask rule language that would be consistent with use of the two-tier approach with an 802.11a (or DSRC-A) mask for lower power levels and the DSRC-C mask for higher power levels. As noted below in Section 2, we still believe that the equities involved call for the DSRC-C mask to be invoked at a lower power level breakpoint than that recommended by NPSTC. However, we have provided two versions of the recommended mask language needed to implement the DSRC-C mask, one for a power breakpoint of 8 dBm scaled to 20 MHz channels as recommended in our August 19, 2004 ex parte filing and another version which would be used if the Commission decides to deploy a 20 dBm breakpoint scaled to 20 MHz channels as NPSTC has recommended.

2. An 8 dBm Breakpoint Provides Improved Interference Protection without Disadvantaging any Manufacturer.

As noted above, there are different opinions in the record regarding the specific power level breakpoint at which the Commission should switch from the 802.11a mask to the tighter DSRC-C mask. NPSTC and Cisco have stated that a breakpoint of 20 dBm is necessary to ensure that multiple manufacturers provide 4.9 GHz products for the public safety market. Motorola has stated that a lower breakpoint, at 8 dBm, provides improved interference protection without significantly impacting product cost.

Therefore, the Commission's ultimate decision regarding the most appropriate power level breakpoint rests primarily on two key issues: a) The impact the decision will have on a competitive equipment market; and b) The level of interference protection needed for public safety use of the 4.9 GHz band.

a. Any Manufacturer can meet the DSRC-C Mask

In our August 19, 2004 ex parte submission to the Commission, Motorola showed that the addition of a filter requiring $3.00 in parts is all that is necessary for a standard 802.11a product to meet the DSRC-C mask. No changes are required to the commercial off the shelf chipsets which all manufacturers will deploy to leverage the 5 GHz U-NII volumes.

Obviously, each manufacturer will determine how this $3.00 in parts costs translates to the price paid by the customer. Clearly, providing this added protection is a not a barrier to entry to any manufacturer and provides no significant cost impact on users.

b. The Appropriate Level of Interference Protection

Given there is no valid evidence that switching to the DSRC-C mask at 8 dBm has any negative impact on a competitive market, the remaining issue is the appropriate level of interference protection that should be provided for this new public safety band. In its August 19, 2004 ex parte filing, NPSTC sets forth one simulated scenario that users could deploy at an incident scene and then conducts analysis which shows the impact of deploying the 802.11a vs. the DSRC-C mask at 20 dBm level yields only slightly greater risks of interference.

At the outset, Motorola agrees that there are operational scenarios which may result in minimal interference. However, there is at least an equal or better chance that users will encounter operational scenarios in which the increase in interference would be much more devastating (*i.e.,* denial of service) than depicted by the NPSTC analysis. In short, the risk that interference will occur, and the impact when it does occur, is driven by the specific operational scenario encountered.

The 4.9 GHz spectrum is a new band provided to support the broadband requirements of public safety. Our experience over 60 years with public safety customers has taught us that with any new band of spectrum, public safety users are ingenious at developing operational ways to use the new communications capabilities that were not initially envisioned. Further, we have learned that while there is some commonality, each jurisdiction determines its own operational procedures at an incident scene. Finally, regardless of the jurisdictions involved, there will be incidents that extend beyond those envisioned today. Prior to September 11, 2001, no one would have predicted the extent of the incidents first responders faced that day. While it is impossible to plan for every scenario, one thing is certain. Public safety users will be better off with more margin against interference than with less.

Motorola believes that due to the limited amount of spectrum available in the 4.9 GHz band (50 MHz), the numerous licensed users, and the numerous user applications and services being requested, there will be channels of various bandwidths, most probably 5 MHz or 10 MHz. There will be a mixture of high power devices for fixed, wide-area networks and low power devices for itinerant, incident scenes. There will be very low power body-worn devices, hand-held devices, vehicle-mounted devices, point-to-point back-haul links, and fixed access points. These devices will be operating at various power levels and with numerous antenna gains and patterns. There will be numerous technologies and/or numerous protocols, requiring separate channels at the same location. At incident scenes these devices will be required to operate in very close proximity (meters apart) and communicate to/from distant devices on weak or obstructed paths.

The mixture of channels, bandwidths, power levels, antenna gains/patterns, adjacent channel emission levels (due to both channel bandwidth and emission mask), and technologies operating in very close proximity sets up a perfect environment for classic far/near adjacent channel interference. Adjacent channel interference is highly dependent upon the differential between the desired and interfering signals. Devices operating at different power levels and with different antenna gains/patterns and different emission parameters increases the likelihood of degradation to links from low EIRP devices and on links to receivers with high antenna gains.

Since this band will likely use TDD technology, the adjacent channel interference scenarios could be base-to-subscriber, subscriber-to-base, or subscriber-to-subscriber.

The effect of this interference may be reduced through-put due to data rate reductions or momentary disruptions in service. However, at very close distances, it will also manifest itself as denial of service. We believe setting the breakpoint lower for the use of the tigher mask decreases the potential for interference, including denial of service, when these devices are operating in very close proximity.

c. The Most Recent NPSTC Ex Parte Filing[1]

As noted above, the likelihood and degree of interference is scenario driven. While much of the scenario that NPSTC depicted could occur, we have the following concerns about the scenario and its analysis and conclusions.

- The incident scene scenario presented by NPSTC assumes all channels are operating at a single bandwidth (10 MHz), with similar devices operating at the same power levels and antenna gain/patterns, and using the same technology (802.11a). NPSTC concludes that there is only a 5-6% reduction in data thru-put by using the two different masks at the same power level. As noted in Motorola's recent ex parte, this is the best case scenario, i.e., all channels operating with the same parameters. Motorola believes that operational parameters will not be homogeneous. Although NPSTC's scenario appears valid for the parameters used, we do not believe it is representative of many incident scene scenarios that will be encountered.
- The NPSTC scenario used up to 8 hops deployed in a multi-hop (mesh-type) system for links which require relatively low data rates, i.e., an average of only 12 kbps. Under heavier loading, i.e. multiple continuous video streams from various points in the system, the data rate is dramatically reduced by the number of hops traversed unless extra protection is provided in the RF physical layer. In a multi-hop system with moderate to high data rate requirements, the potential of reduced throughput and interference mechanisms which cause denial of service increases exponentially unless appropriate interference mitigation steps are taken in the physical layer.

3. Recommended Rules

The rules recommended by Motorola are attached herein. Two sets of proposed rule changes are attached. One set is consistent with the Motorola proposed breakpoint of 8 dBm scaled to a 20 MHz bandwidth. The second set of rules would be consistent with a 20 dBm breakpoint scaled to a 20 MHz bandwidth, i.e, the NPSTC recommended breakpoint.

These rules allow two types of equipment: Class A for higher power transmitters using the DSRC-C mask, and Class B for lower power transmitters using the 802.11a (DSRC-A) mask. Both masks have the same transition points, defined as a percentage of bandwidth, thus ensuring interoperability between equipment built with different masks. The power output for each mask is defined by a constant power density (dBm/MHz). As channel bandwidth changes, the maximum power output scales accordingly so that the power density remains the same. The current FCC rules at 4.9 GHz are based also upon a constant power density (dBm/MHz) in which maximum power output decreases as bandwidth decreases. We see no reason to change the current approach of scaling power output to bandwidth. The recommended rules attached apply this concept using DSRC-A masks versus the DSRC-C mask.

For operation under the tighter DSRC-C mask, we have recommended a maximum antenna gain of 9 dBi for mobile use and 26 dBi for point-to-point and point-to-multipoint use, consistent with the current 4.9 GHz rules. For operation under the less stringent DSRC-A

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[1] *Ex Parte* in Reconsideration of the Memorandum Opinion and Order and Third Report and Order in The 4.9 GHz Band Transferred from Federal Government Use, WT Docket No. 00-32, National Public Safety Telecommunication Council, submitted August 19, 2004.

(802.11a) mask, Motorola has recommended use of a 6 dBi maximum antenna gain. This is consistent with the Part 15 rules applicable to COTS equipment in the 5.2 GHz band. In addition, we note that the NPSTC interference simulation submitted on August 19 used a 6 dBi or less gain antenna for all links with the exception of the bomb squad robot link. Motorola believes that carrying forth the 6 dBi gain for 802.11a COTS devices at 5.2 GHz will help reduce the interference.

4. Summary

In summary, Motorola believes it is essential for the FCC to use the DSRC-C mask for higher power levels to ensure the foundation for signal compatibility across multiple power levels. The specific power level breakpoint at which the DSRC-C mask is invoked is a judgment call the Commission must make based on its interest in minimizing interference for public safety users at the outset rather than after the fact. Given the ease and minimal cost of meeting the mask at power levels of 8 dBm in a 20 MHz channel, a Commission decision establishing 8 dBm as the breakpoint does not present a barrier to entry to any manufacturer, but would help minimize the risk of interference to critical public safety operations and result in more efficient use of the spectrum.

Respectfully submitted,

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Proposed 4.9 GHz Rules With Motorola Recommended 8 dBm Breakpoint Between Class A And Class B Devices

§ 90.210 Emission masks.

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APPLICABLE EMISSION MASKS

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
* * * * *	* * * * *	* * * * *
4940-4990 MHz	L, M…………………	L, M
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(l) Emission Mask L. For Class A transmitters operating in the 4940-4990 MHz frequency band, any emission must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent but less than 55 percent of the authorized bandwidth: At least 26 dB.

(2) On any frequency removed from the assigned frequency by more than 55 percent but less than 100 percent of the authorized bandwidth: At least 32 dB.

(3) On any frequency removed from the assigned frequency by more than 100 percent but less than 150 percent of the authorized bandwidth: At least 40 dB.

(4) On any frequency removed from the assigned frequency by more than 150 percent of the authorized bandwidth: At least 50 dB.

(5) On any frequency outside the channel bandwidth, the power spectral density of the device must meet the attenuation in the mask above or -53 dBm/MHz, whichever is the lesser attenuation.

(6) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

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(m) Emission Mask M. For Class B transmitters operating in the 4940-4990 MHz frequency band, any emission must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent but less than 55 percent of the authorized bandwidth: At least 10 dB.

(2) On any frequency removed from the assigned frequency by more than 55 percent but less than 100 percent of the authorized bandwidth: At least 20 dB.

(3) On any frequency removed from the assigned frequency by more than 100 percent but less than 150 percent of the authorized bandwidth: At least 28 dB.

(4) On any frequency removed from the assigned frequency by more than 150 percent of the authorized bandwidth: At least 40 dB.

(5) On any frequency outside the channel bandwidth, the power spectral density of the device must meet the attenuation in the mask above or -53 dBm/MHz, whichever is the lesser attenuation.

(6) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth

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§ 90.1215 Power limits.

The transmitting power of stations operating in the 4940-4990 MHz band must not exceed the maximum limits in this section.

(a) The peak transmit power should not exceed:

Channel Bandwidth (MHz)	Class A Peak Transmitter Power (dBm)	Class B Peak Transmitter Power (dBm)
1	20	-5
5	27	2
10	30	5
15	31.8	6.8
20	33	8

Class A devices are limited to a peak power spectral density of 20 dBm per 1 MHz. Class A devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 20 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, point-to-point or point-to-multipoint operation (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to

26 dBi without any corresponding reduction in the transmitter power or spectral density. Corresponding reduction in the peak transmit power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.
Class B devices are limited to a peak power spectral density of -5 dBm per 1 MHz. Class B devices using channel bandwidths other than those listed above are permitted; however they are limited to a peak power spectral density of -5 dBm/MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmitter power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 6 dBi.

(b) The peak transmit power is measured as a conducted emission over any interval of continuous transmission calibrated in terms of an rms-equivalent voltage. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement conforming to the definitions in this paragraph for the emission in question.

(c) The peak power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

(d) On any frequency outside the 4935-4995 MHz frequency band, all emissions shall conform to section 15.407(b)(1).

Proposed 4.9 GHz Rules With NPSTC Recommended 20 dBm Breakpoint between Class A And Class B Devices

§ 90.210 Emission masks.

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APPLICABLE EMISSION MASKS

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
* * * * *	* * * * *	* * * * *
4940-4990 MHz	L, M…………………	L, M
* * * * *	* * * * *	* * * * *

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(l) **Emission Mask L**. For Class A transmitters operating in the 4940-4990 MHz frequency band, any emission must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent but less than 55 percent of the authorized bandwidth: At least 26 dB.

(2) On any frequency removed from the assigned frequency by more than 55 percent but less than 100 percent of the authorized bandwidth: At least 32 dB.

(3) On any frequency removed from the assigned frequency by more than 100 percent but less than 150 percent of the authorized bandwidth: At least 40 dB.

(4) On any frequency removed from the assigned frequency by more than 150 percent of the authorized bandwidth: At least 50 dB.

(5) On any frequency outside the channel bandwidth, the power spectral density of the device must meet the attenuation in the mask above or -53 dBm/MHz, whichever is the lesser attenuation.

(6) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

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(m) **Emission Mask M**. For Class B transmitters operating in the 4940-4990 MHz frequency band, any emission must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent but less than 55 percent of the authorized bandwidth: At least 10 dB.

(2) On any frequency removed from the assigned frequency by more than 55 percent but less than 100 percent of the authorized bandwidth: At least 20 dB.

(3) On any frequency removed from the assigned frequency by more than 100 percent but less than 150 percent of the authorized bandwidth: At least 28 dB.

(4) On any frequency removed from the assigned frequency by more than 150 percent of the authorized bandwidth: At least 40 dB.

(5) On any frequency outside the channel bandwidth, the power spectral density of the device must meet the attenuation in the mask above or -53 dBm/MHz, whichever is the lesser attenuation.

(6) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

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§ 90.1215 Power limits.

The transmitting power of stations operating in the 4940-4990 MHz band must not exceed the maximum limits in this section.

(a) The peak transmit power should not exceed:

Channel Bandwidth (MHz)	Class A Peak Transmitter Power (dBm)	Class B Peak Transmitter Power (dBm)
1	20	7
5	27	14
10	30	17
15	31.8	18.8
20	33	20

Class A devices are limited to a peak power spectral density of 20 dBm per 1 MHz. Class A devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 20 dBm/MHz. If transmitting antennas of directional

gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, point-to-point or point-to-multipoint operation (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the transmitter power or spectral density. Corresponding reduction in the peak transmit power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.
Class B devices are limited to a peak power spectral density of 7 dBm per 1 MHz. Class B devices using channel bandwidths other than those listed above are permitted; however they are limited to a peak power spectral density of 7 dBm/MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmitter power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 6 dBi.

(b) The peak transmit power is measured as a conducted emission over any interval of continuous transmission calibrated in terms of an rms-equivalent voltage. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement conforming to the definitions in this paragraph for the emission in question.

(c) The peak power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

(d) On any frequency outside the 4935-4995 MHz frequency band, all emissions shall conform to section 15.407(b)(1).